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ARTICLES

GOODBYE AND GOD-SPEED

PROFESSOR SIR JAMES SCOTT WATSON

I am grateful for this opportunity of writing something by way of a " Last Will and Testament ". For one thing, I have wanted to express my gratitude for the loyalty and devotion of my colleagues, and to say how much I shall cherish the many personal friendships that have grown out of our association during the eight years that we have worked together.

Again, I have wanted to say that, as I think, we can take some pride in our achievement to date. What chiefly matters, of course, is the amount and the quality of the service that we have been able to render to the farming community, and the measure of confidence that we have been able to inspire in the minds of its members. I think it can hardly be doubted that, in these respects, we have done well. But also we have learned to cherish, and live up to, the high traditions of the Civil Service, to understand its ways, and to achieve increasingly harmonious relations with our administrative colleagues. In this last context we owe a particular debt of gratitude to the late Charles Nathan, who was our Assistant Secretary during the time when the general plan was thought out. Nobody can know, as well as I know, how wisely and understandingly he guided our first uncertain steps.

Let us look at some of the doubts and difficulties with which we were confronted at the outset, and consider how far these have been resolved. Perhaps the greatest misgivings, in the early days, were about the decision to associate our Service, in the counties, with the Executive Committees. On the one hand was the fear that, in cases where a Committee felt obliged to take action against an individual farmer, the adviser would be faced with a conflict of loyalties—to the prosecutor on the one hand and the defendant on the other. In the event, while we may have, on occasion, persisted too long in our efforts to help lame dogs, I can recall only one charge (which was never substantiated) of informing or of victimization.

On the other hand was the fear that advisers (and particularly District Officers) might be saddled with a burden of miscellaneous duties so heavy as to prevent their " actively purveying " advice.

The load has indeed sometimes been over-great, and in some districts—especially those in which the Hill Farming and Livestock Rearing Acts are operating—it may still be heavier than we could wish. Moreover, the old argument—to the effect that an administrative inquiry provides an excuse for an uninvited call on the farmer who needs, but has not sought, advice—has diminished force today. In any case we must recognize the fact that the combination of duties has made for economy of manpower.

Criticism was also evoked by the decision to remove the science specialists from the universities and colleges to the N.A.A.S. Provincial Centres. Something, indeed, has been lost by the change; contact with university teaching and research was stimulating, and the moderate volume of routine work left the adviser with time for personal research on problems largely of his own choice. Today, the volume of routine work—soil analysis, plant disease diagnosis, bacteriological examination of farm water supplies, and so forth—is such that there is little opportunity for independent research. But if there has been some loss, there has also been great gain. Vastly more use is now made of the science specialist's services, and a steadily increasing proportion of the problems submitted is being solved. Again, District Officers are kept in much closer touch with current research and scientific thought, and the specialists, both in the Sciences and the Husbandries, have been given much improved facilities—on the Experimental Husbandry Farms and Horticultural Stations as well as in the farmer's fields—for subjecting their ideas to the test of practice.

With respect to the Husbandry Specialists, there were two obvious defects in the Advisory Services as they existed in 1939. On the one hand, the specialties then recognized—horticulture, dairying and poultry husbandry—offered quite inadequate career prospects; on the other hand, the county team as a whole lacked support in dealing with husbandry problems, and too often failed—through no fault of their own—to keep abreast with technical progress. Some would say that we have not yet gone far enough: that, like some other countries, we should have specialists in pigs and potatoes, weed control, fodder conservation and other relatively narrow fields. The time may come, indeed, when it will be desirable to take specialization a stage further. On the other hand, I believe that we should stand fast by the principle that the farmer in need of advice should have recourse, in the first instance, to a general practitioner possessed of the fund of local experience that means so much.

The most persistent criticism of our organization has been on the score of its "divorce", at county level, from agricultural education. It is part of our task to show that there need be no divorce. The degree of co-operation that has already been achieved varies from one county to another. Some Education Authorities have asked for more help than, with the best will in the world, we could provide. Others

have asked for much less than we would willingly have given. Perhaps in some matters we ourselves have done less than enough : for instance, in providing opportunities for field experience to young members of institute staffs. But progress continues, and in many counties the degree of co-operation now leaves nothing to be desired.

Perhaps the greatest disability under which we started was the too narrow range of our own competence. I think it is true that, from the early days and throughout the whole field of agricultural research, education and advisory work, there has been too much emphasis on the natural sciences and altogether too little on the other basic disciplines. Most of us who aspired to be teachers or advisers were well enough trained in chemistry, physics, biology and so forth, and in the application of these subjects to crop and livestock production. But we had nothing but the scantiest introduction to economics and its application to the farming business. Moreover, we should have achieved a fuller understanding of farming as it is if we had been taught more about how it has come to be.

It is true that the adviser who starts as a scientist and a technician, with some training in the crafts, may, in course of time, acquire a high degree of competence in regard to the organization and operation of the farm business. Indeed, it was not very unusual for one of the old generation of County Organizers to be called into consultation about financial problems or labour relations, or even to arbitrate in family disputes. But if we are to meet the growing volume of demand for advice on farm organization and management we must rely, in the main, on the District Officer, and we must try to equip him for the task.

As it has happened, the one-sidedness of our approach has not, up to the present, had any calamitous consequences. Until very recently the national need has been for higher production, and prices have been such that the higher production could commonly be expected to bring higher profit. But greater production in itself is no longer enough. The aim must also be to help the farmer to reduce his costs. We must, then, scheme for a marriage between better husbandry and better business. I hope that the marriage can be arranged, and that it will prove happy.

There will be other problems in the years to come, and perfect solutions will rarely be found. But I am happy to leave the future in your hands.

SOIL ORGANIC MATTER

A Review of a Conference

The importance of soil organic matter, traditionally accepted as a major factor in the maintenance of soil fertility, has been much discussed and often disputed in recent years. Many continue to assert the overriding importance of soil organic matter in a sound farming system, but others take a different view, preferring to rely on inorganic fertilizers to maintain crop yields. Although in general its importance is still widely accepted, modern farming systems do not always ensure the addition to the soil of the quantities or forms of organic matter formerly considered necessary. For instance, divergent views are often expressed on the value of green manuring, and much argument has recently centred around the disposal of cereal straw which, from being regarded as a valuable by-product and a basic constituent of farmyard manure, has come to be looked upon as little more than a nuisance on some farms.

The stockless farm is well established in several arable areas, and the stockless farmer, usually with the help of liberal dressings of fertilizers, claims crop yields at least as good as his neighbour's. His critics may accuse him of soil-mining, of failing to maintain the fertility of his soil, or of robbing posterity, but he can often point to a long record of good yields with no apparent deterioration in the soil.

Because of these conflicting views, it seemed desirable to examine the evidence obtained in some of the experiments on the use of dung and other forms of organic matter in the light of the experience of practical farmers following a wide variety of farming systems, and of advisory officers concerned with soil and crop problems. A conference was therefore arranged in the Eastern Province on May 13, 1954, to afford an opportunity for free discussion of this very perplexing problem; farmers, research workers and advisory officers attended. The Chairman was Mr. F. Hanley of the Department of Agriculture, University of Cambridge, and the following papers were given:

*The Importance of Organic Matter to Crop Plants.** Dr. G. W. Cooke and Mr. H. V. Garner (Rothamsted Experimental Station).

Green Manuring. Dr. H. H. Mann (Woburn Experimental Station).

Work at Jealott's Hill. Mr. A. E. M. Hood (I.C.I. Ltd., Jealott's Hill Research Station).

Experiences with Ploughed-in Straw. Mr. J. H. Cock (Abbey Farm, Guestwick, Norfolk).

Organic Matter in some Eastern Counties Soils.† Dr. N. H. Pizer (Provincial Soil Chemist).

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*To be published in full in the Journal of the R.A.S.E.
†Published in full in No. 25 of this REVIEW (Autumn, 1954).

The discussion was opened by Mr. S. Culpin (Farm Director, Gleadthorpe Experimental Husbandry Farm) who kindly deputised for Mr. Frank Rayns who was unavoidably absent.

This article reviews the papers and the discussions but, in the interests of brevity, detailed experimental results have been excluded. For readers desiring fuller information, a list of references is given on pp. 62-63.

The Importance of Organic Matter to Crop Plants

Dr. G. W. Cooke opened the conference by reading a paper by Mr. H. V. Garner and himself in which the importance of organic matter to crop plants was reviewed. He pointed out that the presence of organic matter was not a fundamental requirement for plant life; its influence was exerted indirectly either by supplying nutrients (not necessarily in an immediately available form), by improving the water holding capacity of the soil, or by improving the physical structure of the soil. This physical improvement may be either (1) an opening of the soil due to the incorporation of undecomposed residues, or (2) better aggregation of the soil particles into crumbs due to decomposed organic matter. The physical effects of organic matter could be measured by laboratory techniques, but, in the field, crop yield was the only worth while criterion.

It was pointed out that organic matter was not a synonym for soil fertility. By soil fertility, Dr. Cooke meant the capacity of a soil to grow crops; this was affected by cultivations just as much as manuring. While it was desirable for a farmer to build up his soil fertility, Dr. Cooke did not think reserves of soil organic matter should be built up at the expense of profits. In practice, it was difficult to increase soil organic matter reserves indefinitely, and conversely, it was difficult to deplete these reserves completely.

Turning to a review of experimental data, Dr. Cooke mentioned first the results from Tunstall. These showed over a period of years that a coarse sandy soil with only 1 per cent organic matter could be maintained in a reasonably productive state by liming and applying nitrogen for all crops, supplemented by phosphates and potash for roots. Other long-term trials at Saxmundham (on boulder clay) Woburn (Greensand) and Rothamsted (clay with flints) had compared dung with fertilizers. The yields produced were, in general, very similar, whether dung or fertilizers were used, although the quantity of fertilizers applied was far below modern practice in many of these trials.

Dr. Cooke pointed out that errors could be made by evaluating dung on its nutrient content as revealed by analysis, without allowing for the availability of these nutrients. He referred to the need for maintaining nitrogenous manuring even when dung had been given, though some economy in potash and phosphates was permissible.

Straw contained small amounts of nutrients, and its value had been investigated in a trial at Rothamsted over the past twenty years. The rotation potatoes—sugar beet—barley was used; straw was ploughed-in in the autumn and compared with composted straw and no straw. The ploughed-in straw plots received fertilizers either in the spring, or partly in the autumn and partly in the spring. Straw compost was most disappointing, yields usually being below those of crops grown from fertilizers only. Ploughed-in straw gave slight increases in yield (mainly in the potato crop) when fertilizers were applied in the spring. These increases, expressed in cash, amount to £5 per acre in the three year rotation from ploughing-in straw compared with a loss of £35 by composting the straw. No allowance, however, had been made for the value of the straw. Dr. Cooke thought the explanation of these results was that the straw was supplying some potash (of especial value to the potatoes) but locking up nitrogen, which was needed by both beet and barley. He hoped that future modifications of this experiment would show whether the bad effects of straw could be overcome by extra fertilizers.

Temporary leys were an alternative method of maintaining fertility. Dr. Cooke referred to some work in the east of Scotland by Dr. Smith of Edinburgh, which showed that the residues of a cereal crop supplied as much organic matter as 5 tons of dung, but a much smaller amount of nitrogen. In that climate, undersowing the stubble with ryegrass or red clover doubled this amount of organic matter but did not necessarily increase the yield of the following crop. Unless leys contain abundant clover, they must be done well with nitrogen if they are to keep up fertility.

Further evidence on the value of a ley was being obtained at Woburn. Even a one-year ley raised the yield of the next crop (potatoes). Lucerne gave larger increases and a grazed three-year ley higher yields still. When muck was given to the potatoes, yields went up, even after the grazed ley. It is difficult to decide in practice whether the sacrifice of three years arable cropping is justified by the higher yields obtainable after the ley. This depended on whether the grass could be cashed profitably.

Dr. Cooke summed up his paper by reviewing the place of organic matter in modern farming. He suggested that it could not pay to provide nutrients in the form of dung since 10 tons of dung contained on average about £6 worth of nutrients. Dung should be a by-product of a profitable livestock enterprise, just as leys should not be grown just to fix nitrogen. The physical effects of organic matter may be of prime importance and some of these effects cannot be achieved in other ways. On the other hand, some effects may be little more than an insurance against bad husbandry.

Discussing three important soil types in East Anglia, Dr. Cooke said the Tunstall results showed that organic matter was not essential

on a coarse sandy soil, with naturally good drainage and aeration. On clays, where good crumb structure is obtainable by frost action or judicious cultivations, extra organic matter apart from crop residues may not be essential. However, on fine sands and silts, depletion of organic matter reserves resulted in difficulty in cultivation, in capping in wet weather, and in impeded aeration and drainage. To ensure full arable crops on such soils, aggregation into stable crumbs is a necessity, and organic matter must be supplied either by dung or grass leys or the residues of other crops. There is difficulty in establishing ley farming systems in areas where animal husbandry is not traditional, and such systems mean reduced income compared with cash cropping. Dr. Cooke expressed his conviction that eventually science would be able to define the necessity for soil organic matter more precisely, and perhaps could produce an alternative, possibly by soil conditioners, to making muck at a loss or introducing unprofitable grass leys.

Green Manuring

Dr. H. H. Mann reviewed research work in connection with organic matter which had been conducted at Woburn over half a century. When this programme was begun organic matter was regarded mainly as a means of accumulating nitrogen in the soil, but other problems concerning soil organic matter have been studied more recently.

When organic matter was applied to an ordinary soil, the crop response obtained at Woburn seemed to be related to the amount of nitrogen and other nutrients supplied, rather than to the quantity of organic matter. If the content of nitrogen was low (less than 1.8 per cent) the immediate effect was a reduction in crop yield, and after a long period—which might be up to two years—the maximum benefit of the application occurred. For ordinary plant residues, such as those applied as green manures, their efficiency increased after application and exerted a maximum effect for a period which might be short: the duration of the benefit depended on the percentage of nitrogen contained in the applied material. Once the maximum effect had been exerted, the value of an organic manure declined rapidly, and the residue left in the soil had little effect on crop yields, except as a source of plant food (such as phosphates or potash) or as an improver of the physical condition of the soil. This residue appeared to be similar in character whatever the origin of the organic matter.

The Woburn experiments indicate that accumulation of organic matter in a cultivated soil is not justified as far as direct fertilizing value is concerned. It may have incidental effects by improving the physical condition of the soil and increasing its water-holding capacity, but as a direct manure, its value depended on the content of nitrogen. If this was low, the immediate effect may be injurious to a growing

crop; if it were rich in nitrogen, it must be followed quickly by a crop which can utilize its value when the latter is at a maximum.

The question of ploughing-in cereal straw can be answered fairly certainly by saying that such material will not lead to any improvement of an immediately following crop, and may be injurious. There might be residual effects in the following year, if, as the point of maximum efficiency is reached, there is a crop growing which can take advantage of the nutrients supplied.

Work at Jealott's Hill

Mr. A. E. M. Hood discussed the return of organic matter to the soil, with reference to two rotation experiments which had been conducted at Jealott's Hill since 1945. The results of these experiments have not yet been published.

The first experiment compared continuous cereal-growing with four-course arable rotations of three cereals and a "renovating" crop. There were five of these rotations using one-year leys (grazed or mown), rape, mustard, or bare fallow as renovating crops. In addition, the effect of removal, burning or ploughing-in straw from the cereals was examined at two levels of nitrogenous manuring.

Discussing first the results obtained from three methods of straw disposal, Mr. Hood pointed out that there was little difference in grain yield after the three methods of straw disposal. Ploughing-in had not shown any benefits, but in dry years it had reduced yields, especially at the lower level of nitrogen.

Comparing the rotations, the lowest yields were given by continuous cereal-growing. This was largely due to the occurrence of Take-all. In the early years of the experiment, yields after leys were inferior to yields after mustard, rape or fallow. More recently, this trend had reversed and it had been observed that crumb structure and porosity were improving on the land where leys had been grown.

The second experiment was designed to study the effects of lengths of ley of from one to three years on soil fertility and crop yields, in comparison with continuous arable cropping. The effects of adding 50 cwt. organic matter per acre in the form of dung and of composted wheat straw, applied once in the rotation, were also measured.

Organic manuring had so far given small responses, compost being if anything inferior to dung. The leys, however, had shown striking effects on the succeeding kale crop. Crops following one-year and two-year leys were better than those following arable cropping, but yields after three-year leys did not appear to be superior to those after two-year leys. Kale was followed by wheat, which again showed yield increases following leys in comparison with continuous arable cropping. The protein content of both kale and wheat was higher after leys than after continuous arable.

Finally, Mr. Hood showed that, for the first experiment, the organic matter content of the soil had fallen during the period 1944-51. The fall had been least in the " ley grazed " treatment and most on the fallow and continuous cereal treatments. In the case of the second rotation experiment the organic matter content of the soil had, over the same period, been maintained by the three-year ley, slightly reduced by the two-year ley, further reduced by the one-year ley and markedly reduced by the continuous arable treatment. The application of organic fertilizers had not prevented loss of organic matter under continuous arable, or under a one-year ley rotation, but enabled a slight increase in organic matter to take place under the rotation which included the three-year ley.

Experiences with Ploughed-in Straw

Mr. J. H. Cock, Farm Manager to the East Anglian Real Property Co. Ltd., described his experiences in ploughing-in straw. The 6,400 acres of land comprising the estate contained a typical range of Norfolk soils including light land where organic matter was thought to be of considerable importance and also heavier land and some medium loam. During the last 25-30 years practically no livestock have been kept, and even after this length of time the methods adopted appear quite successful. Crop yields compared favourably with more orthodox methods, were steadily increasing, and showed no sign of any decline. The rotation followed very closely the old Norfolk four-course, and consisted of 50 per cent cereals, 25 per cent roots (20 per cent sugar beet, 5 per cent potatoes), 12½ per cent peas and beans, and 12½ per cent miscellaneous (grass for seed, one-year clover leys and a little lucerne). In 1946, farming on this system, there were about 3,000 acres of straw to be sold off, and the proceeds from this sale very nearly met the fertilizer bill. Selling the straw was a fairly straightforward matter, since all corn was cut with a binder, threshing was done from the stack, and the straw was baled. With the introduction of the combine, the extra cost of collecting the straw could offset much of the saving made by the use of the combine harvester. The estate was, therefore, faced with a problem of straw disposal.

Both the economic and the long-term fertility aspects of the problem were considered. Available evidence was found to be conflicting. In many parts of this country, and in Holland, it appeared likely that fertility could be maintained without utilizing the straw, and experimental work seemed to justify this practice. There seemed every indication that fertilizers alone were satisfactory, bearing in mind the fact that very considerable organic residues from other crops were being returned. Composting the straw had been considered, but the unfavourable results at Rothamsted, and the cost of composting, ruled it out. Some experimental work at Sprowston, however, appeared to contradict much of the other work, and a measurable response to ploughed-in straw was obtained. In addition, it seemed

likely that if a higher level of manuring had been used in the Sprowston trial, a response comparable to that from farmyard manure might have been obtained. The conclusion was reached that an effort should be made to plough-in as much straw as possible, and consequently a decision had to be made on the amount of capital and annual expenditure worth while to enable straw to be ploughed-in on the estate.

Several different methods were tried. Straw was spread behind the combine for ploughing-in, but efficient ploughing was not easy and there was an obvious need to break up or to anchor the straw to the ground. Discing did some good, and weeds and trefoil growing through helped, but it was not easy to get thick layers of straw into a fit condition to plough-under. Furthermore, the preliminary work on the straw, and the lapse of time necessary to enable trefoil to grow through, seriously delayed the commencement of ploughing in the autumn, and, on the more difficult soils, materially reduced the standard of ploughing. Rotary cultivators were tried and proved very satisfactory on light crops of straw, but could not cope with a heavy crop. The machines were also slow and had a high maintenance cost. A programme of weed spraying in spring complicated the use of trefoil; spraying often resulted in late undersowing, which meant that little growth of trefoil was made. Ploughing-in straw accordingly involved a good deal of preliminary mechanical work, at the end of which the real cultivations had not been started, and stubble cleaning became impossible. The cleanliness of some of the fields declined. Digger ploughs had to be used throughout, which often meant that only two furrows could be pulled instead of three, and on some of the land it was difficult to do good work. In a few extreme cases ploughing could only be done with a prairie buster which added to costs and made the autumn work even later.

Chopper blowers were also acquired which would pick up the straw, chop it and return it to the land. This enabled normal stubble cleaning to be done and facilitated ploughing but it was very expensive, slow, and locked up high-powered tractors during harvest and immediately afterwards. It could not be worked continuously behind the combine, because the chaffed straw blew a considerable distance in a high wind and gave rise to complaints. On the other hand, if the straw were wet, the efficiency of the machine was considerably reduced.

After three years, it was concluded that unless there were likely to be obvious increases in yield or improvement in soil conditions, ploughing-in straw was not worth while. Observations did not indicate that any benefit was being obtained, and there was no further evidence from experimental work to justify continuing. The original programme of selling straw off the farm seemed to be the best policy. Where possible straw is sold as it lies on the field, the buyer to bale and remove. The demand for straw is limited, but if it can be sold, the income is about £1 per acre. Straw that cannot be sold is burnt.

Mr. Cock found that this procedure made the whole job of farming very much easier and it contrasted with the difficulties and delays inherent in the alternatives. Many details in the effect of this programme remain to be answered, but it should be remembered that straw was not the only form of organic matter available for return to the land, a considerable contribution being made by the sugar beet tops. Many years ago it was widely thought that sheep were essential for the maintenance of fertility: since then it has been found that we could do without sheep, and nobody would now suggest that farming without sheep reduced the fertility of the land. Mr. Cock was convinced that the standard of farming is as high or even higher than ever, not only on this Estate, but also on much other land farmed on a similar system.

Organic Matter in some Eastern Counties Soils

Dr. N. H. Pizer, discussing organic matter in the eastern counties, pointed out that although several experiments had been carried out in the Province, most of these were on soil types which occurred to a limited extent only. None of the experiments had been carried out on a soil with a high content of silt or fine sand where soil structure tended to be unstable. Experience had shown that capping and crop damage due to a break-down of unstable structure in wet conditions could be minimized by maintaining a reasonable organic matter content.

Dr. Pizer said that organic contents of 3-5 per cent were commonly found in eastern counties soils where long leys played an integral part in farming systems. Under continuous arable cropping, without leys or livestock, organic matter contents of 2-3 per cent were frequent and in extreme cases even lower figures had been recorded. Dr. Pizer proposed that soil organic matter contents in the province should be classified as follows:

(1) Less than 1 per cent—Extremely low. Found where serious problems occurred. A dangerous condition requiring urgent action to restore organic matter.

(2) 1-2 per cent—Very low. Instability of soil structure found; also the bad effects of layering and panning in soils. Uneven response of crops to nitrogen and a higher demand for nitrogen.

(3) 2-3 per cent—Low. Physical problems in some seasons in situations with impeded drainage.

(4) Over 3 per cent—Satisfactory.

Loss of organic matter could occur through oxidation, erosion, or through the dilution of top soil and improved aeration following deep ploughing. The return of organic matter in arable farming depended mainly on crop residues. Dr. Pizer thought that, under

East Anglian conditions, the chief crop residues of value as a source of organic matter were the roots of cereal crops and sugar beet tops.

He estimated the returns of organic matter from crop residues to be as follows:

Roots—½-1 ton organic matter per acre from cereals.
—1-2 tons organic matter from the roots of clovers and grasses.
—very little from potatoes and sugar beet.
Tops—1-1½ tons organic matter from the straw of cereals.
—1½-3 tons organic matter from the tops of sugar beet.
—very little from potatoes.

The final addition to the organic matter of the soil would vary according to the nature of the crop residues; mature plant tissues breaking down more slowly than soft leafy tissues and leaving a larger residue in the soil. It was impossible to specify whether all crop residues should be returned or not; much depended on the level of organic matter in the soil.

Dr. Pizer concluded by pointing out that, under conditions of low soil organic matter, patchy crops frequently occurred in East Anglia, and it seemed that low organic matter status might well be the cause of the trouble. He stressed his conviction that fundamental experimental work on soil organic matter must be conducted on soils deficient in organic matter, in the belief that responses, like those to mineral nutrients, will increase at low levels. Dr. Pizer quoted some striking results, obtained from dung, straw and sugar beet tops on a loamy fine sand at Docking, Norfolk, with under 1.3 per cent organic matter.

Discussion

Mr. S. Culpin referred to the experiments on straw disposal carried out at Sprowston on light land on a four-course rotation of sugar beet, barley, one-year ley, wheat. The sugar beet had given little response to ploughed-in straw but there were residual effects on the barley and the one-year ley. Straw ploughed-in for wheat had given 3.8 cwt. per acre extra grain, which could not be accounted for by the additional nitrogenous fertilizer applied to rot the straw.

Referring to Dr. Mann's paper, Mr. Culpin wondered whether maximum efficiency would be reached more quickly if the material was left on top of the soil as a mulch. He thought that there might be a place in farming for straw mulching if suitable techniques could be evolved. He thought that there was a great difference between raw straw and partially decomposed straw, particularly if the latter were grown through with some green crop.

Referring again to the Sprowston experiments, Mr. Culpin stated that dung had proved better than equivalent amounts of straw, the response to small amounts being really striking. Wheat receiving

5 tons F.Y.M. had yielded an extra 5.6 cwt. per acre. Sugar beet receiving 6 tons F.Y.M. per acre had given an average response of 3 tons per acre. The residues of the dung gave on average an extra 4.4 cwt. per acre barley grain, and an extra 15 cwt. per acre hay. The cumulative effect of dunging was clearly shown as the responses rose steadily; this effect was due to yields without dung or straw going steadily down. The parts played by nutrients and by physical effects could not be distinguished, but as the soil was a fine sand it might, as Dr. Pizer suggested, respond well to applied organics because of their effect on structure.

He thought the work at Woburn would shed new light on many old experiments; in particular, on pre-war trials in Norfolk on the best time to plough up one-year leys. It was found that wheat after a bastard fallow gave a strong autumn growth and finished poorly, whereas wheat after a ley ploughed in the autumn, although developing slowly, gave the best yield in the end. This could now be explained by the maximum release of organic nitrogen taking place at different stages in the life of the wheat crop. Following this up, schemes of cropping should be designed to fit the supply of nutrients released from applied organics.

He thought that "making muck at a loss" had been over emphasized. Mechanization of muck shifting coupled with a good layout of yards eased the job. Yarded cattle could be more easily fed than those out-wintered, and did not despoil pastures. Mr. Culpin thought the economic side of returning organic matter to the soil must be carefully considered. He referred to the beneficial effect of leys on the sandy soils at Gleadthorpe, but had no doubt that including leys tended to reduce cash income from the farm.

Dr. Pizer, referring to Mr. Culpin's point on the application of straw as a mulch, said that this practice had proved of great value in treating orchard soils which had a poor structure.

Mr. T. J. Caudwell (Farmer, Lincs.) stated that in his experience a three-year ley only raised the soil organic matter content by 0.25 per cent and asked if any other method was likely to be quicker. In reply, Dr. Pizer indicated that organic matter content was only one aspect of the effect of the ley; it was possible to improve soil granulation markedly by a ley without much increase in organic matter content.

Mr. Caudwell wondered whether seeds mixtures other than a ryegrass ley would be more beneficial. Dr. Pizer felt that cocksfoot was probably a more efficient structure-restoring grass than ryegrass, and Mr. Rhys Williams (Provincial Grassland Officer) stated that research work was proceeding at Aberystwyth on the development and effects of rooting by grasses. He wondered whether enough attention had been given to the "placement" of organic matter—the effect of superficial application followed by discing or rotary cultivating

compared with ploughing-in. He asked Mr. Hood for details of the management of his leys.

Mr. Hood said that grazed leys were grazed by sheep five times annually ; mown leys had the aftermath grazed. Root development studies showed that more roots were formed in the mown leys.

Mr. W. H. Wallace (Farmer, Herts.) inquired whether deep ploughing was likely to reduce soil organic reserves. Dr. Pizer replied that some dilution of the topsoil was inevitable during deep ploughing, but that many troubles such as plough pans could only be cured by deep cultivation.

Mr. W. H. C. Peacock (Farmer, Norfolk) expressed the opinion that it was possible to plough too frequently, and that a one-year ley had more value on his land than the quoted experimental results indicated. He asked Dr. Pizer whether protection of the soil from sun and wind could be responsible. Dr. Pizer doubted whether sun and wind could have as large an effect on soil texture as other climatic factors, such as wetting and drying.

Mr. F. E. Shotton (N.A.A.S., Norfolk) thought that any discussion of the value of a ley must take into account the organic status of the soil. He enquired what the normal organic matter content was in the Woburn soils. Dr. Mann (Woburn) said that the Woburn land was not naturally very deficient in organic matter, having about 3 per cent. He strongly supported Dr. Pizer's point that marked granulation could occur without an appreciable rise in organic matter content.

Referring to Mr. Culpin's point about rotations being planned to use green manuring efficiently, Dr. Mann stressed the importance of not burying green manures too deeply, as well as of not ploughing-in too long before a crop is sown. Mr. Culpin said that in the Sprowston experiments straw chaff was applied to the ley in March and not ploughed-in until September.

Mr. J. C. Green (Farmer, Lincs) referred to the fall in yield experienced at Sprowston if no straw were returned, and wondered whether Mr. Cock might experience this later. Mr. Cock said that the level of fertilizer use must be considered. At Sprowston, the yield reduction occurred on plots receiving no fertilizer, except 8 cwt. per acre for sugar beet. On his land, using more generous fertilizers, yields were rising steadily. Mr. Culpin stated that he considered 8 cwt. of fertilizer, containing 3 cwt. nitrate of soda, 3 cwt. superphosphate and 2 cwt. potash salts, adequate for beet, although the other crops would have benefited from manuring.

Mr. J. N. Sharrock (Crop Husbandry Officer, S.E. Province) doubted whether Mr. Cock's system was seriously depleting his organic matter reserves, but wondered whether new varieties were responsible for the yield increases. Mr. Cock said that the value of

sugar beet in maintaining fertility was often under-rated. Regarding varieties, similar increases were recorded in all crops, including sugar beet, where there was no evidence of any superiority in the more recent varieties.

Mr. J. A. Matthews (Farmer, Essex) supported Mr. Cock's policy. On his boulder clay farm he cashed his straw and bought in fertilizers. He could not regard leys as economic, but regarded lucerne as an invaluable means of putting heart into a field. His experience with sugar beet was that yields were better on the boulder clay hills than on the silty valley soils rich in organic matter.

Mr. Rickwood (Farmer, Isle of Ely) said that despite the arguments he had heard, he wondered what value a farm would have after a long period of stockless farming. He stressed the need for taking a long term view of all aspects of soil fertility. Earthworms, which had not been mentioned, might be of great importance. Mr. Cock, however, was doubtful whether modern farming methods really robbed the soil; on his own farms soil phosphate reserves were rising.

Dr. Cooke, replying to the discussion, first referred to Rothamsted work on earthworm populations, which showed that these remained at a high level under inorganic manuring. He felt that the problems of mechanizing dung production had not been fully stressed; frequently capital so invested could be better used elsewhere. He had no doubts that posterity would commend this generation for its reclamation of derelict land, and he had no qualms about the propriety of cashing assets left by earlier generations. Regarding the Sprowston trials, he stated that 8 cwt. of complete fertilizer was below the optimum for sugar beet, as indicated by the trials, and thought that the effects of straw quoted by Mr. Culpin might well be due to potash.

Dr. Pizer, commenting on Mr. Matthews' experiences, said that Boulder Clay was an excellent sugar beet soil. The accumulation of organic matter in the valley soils indicated that they must be either wet, acid, or excessively dry. Any of these factors would make them unsuitable for beet.

Mr. A. J. Gane (N.A.A.S., Herts) was concerned at the high ingoing likely to be demanded, owing to heavy fertilizer expenditure, when a "land flogger" gave up. Mr. Matthews and Mr. Dadd (Provincial Crop Husbandry Officer) made a distinction between stockless farming, which could be long-term, and "land flogging" which was a "get rich quick" process. Any system of farming maintaining output and keeping up profits over a long term was fundamentally sound. Mr. Dadd pointed out that traditional beliefs were not necessarily valid for ever in the face of changing circumstances and recent technical advances.

Mr. Caudwell questioned Dr. Cooke's views on the cashing of assets; he thought that since land was irreplaceable it must be handed on to the future in sound heart. Mr. J. A. Birch (Fisons Ltd.)

thought that herbage seed production offered an alternative to unprofitable leys, and Mr. J. Thacker (N.A.A.S., Beds) pointed out that the experimental data referred to rotations which were on traditional lines. Many rotations now being practised were far more unbalanced, yet the farmers claimed to be increasing yields.

Mr. Rickwood stressed that the yield improvement due to the improved varieties now available was often not appreciated. He asked Dr. Mann what light the Woburn work had shed on the optimum time of applying muck for roots or wheat. Dr. Mann replied that muck consisted of a readily available fraction (which was used up in 4-6 weeks) and a more slowly acting fraction available some six months after application. Ideally, a growing crop must receive the nutrients of both fractions. For wheat, it followed that dung should be applied near to the time of drilling.

Mr. P. J. O. Trist (N.A.A.S., East Suffolk) referred to mechanization and the progress in the technique of cultivation. Great yield increases could be achieved by timely ploughing and allowing the winter to make a tilth without the need for heavy spring cultivations.

Mr. F. Hanley summed up the conference. He said it was clear that organic matter was of more importance on some soils than on others ; on those containing a large proportion of fine sand it seemed to be especially important. It was clear that organic matter levels much below 3 per cent could cause trouble, but increases over this level were not necessarily reflected in yield responses. The type of material—especially its nitrogen content—was particularly important in relation to the time of application. Physical benefits are only reflected in crop yields on some soils, and nutrient supply seems more important in accounting for some trial results. On very light land, organic matter has especially value in preventing blowing and in maintaining water supply to crops, but leys involve a reduction in financial output. The problem of straw disposal was controversial, but there were clearly practical difficulties in attempting to plough-in straw as a regular practice. Leys, especially the longer leys, were of value as a source of organic matter, if they could be fitted into a farming system. Finally Mr. Hanley referred to the long-term imponderable factors. To base our policy solely on crop yields, as shown by experiments, ignored basic aspects which might be important.

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CORRECTION

N.A.A.S. Quarterly Review No. 25 page 18

The word " sheep " should be substituted for " rabbits " in line 14 of the article *Bloat ; The Work of the Provincial Bloat Study Groups*, by A. J. L. Lawrence.

ABSTRACTS

ANIMAL BREEDING

Progeny Testing of Farm Animals

The advisability of embarking on a programme of progeny testing must be judged by both theoretical and practical considerations. This is the subject of eight papers published in the 1952 and 1953 Proceedings of the British Society of Animal Production. It is intended here to summarize the findings of these papers. For convenience in this summary it will be assumed that it is intended to test males, although the same considerations apply when testing females.

One of the main uses of the progeny test is to improve the accuracy of selection for quantitative characters ; that is, those influenced by many genes. Usually, progeny testing must be regarded as a supplement to earlier selection and only rarely its sole basis. The test provides greater accuracy in assessment of traits, but also lengthens the generation interval because selection comes later in the life of the animal than with most other forms of selection. Only when the advantages of accuracy outweigh the disadvantages of delay should a progeny test be used. A balance in favour of the test will usually occur when heritability is low ; when the character is measured in only one sex or after slaughter ; and when the size of the breeding unit is large. A low heritability implies that only a small fraction of the total observed variation for the trait is caused by the average (additive) effects of genes. In this category there are many economic characters in farm animals ; for example, milk yield, litter size and weaning weight. Consideration must also be given to the question whether to test many animals with a few progeny each, or a few animals with many progeny. Here the balance is between accuracy of judgment and choice among sires, each judged on less information. A prerequisite of every progeny test is that the mates of the sires for testing should be chosen at random.

The number of progeny needed for the test depends on the heritability of the quantitative character ; on the situation under which the test is made ; and, of course, on the degree of " accuracy " required. It is a sobering thought in this connection that, for a character like milk yield, with a heritability of about 30 per cent, a bull needs to be judged on the records of five daughters to provide the same amount of information as a simple lactation gives for a cow. A number of methods of progeny testing are available. Thus it may be done in one herd for which the management level is kept as constant as possible. This is the situation aimed at in Denmark at their special testing stations for cattle and pigs, and by a British firm in its litter-testing scheme. Comparison is then

directly between the performance of the different sire groups of progeny. A second method is to test sires in herds at different environmental levels. Objections to this procedure are based on the presence of correlations between daughters in each group due to common environment, and the lack of knowledge about genetic differences between herds. A third assessment of sires makes use of large numbers of daughters distributed virtually at random over widely differing levels of management. This will happen with sires used for artificial insemination.

A comparison was made on Danish cattle data of the first and last of the three methods of progeny testing mentioned above. Eighty-five bulls with daughters in special testing stations also had daughters milking in commercial herds. The correlation between the daughters in these two groups was over 0.6 for both milk yield and fat percentage, but the results from special stations showed a greater variation between bulls. From the station results it was thus possible to pick good bulls with greater accuracy. This, however, must be weighed against other practical considerations, such as the cost. The Milk Marketing Board are using specially picked herds in which to test bulls for use at artificial insemination centres. About 150 inseminations per young bull are expected to lead to 20-25 first lactation records. In pig litter-testing and boar testing, uniform environmental conditions are usually aimed at; four offspring are tested from each litter. In sheep, particularly hill sheep, special problems of recording and interpretation arise. It is necessary to decide, for example, whether to test under the conditions in which the animals will be asked to perform, or under different (and often better) conditions. The former is recommended in these papers because little is as yet known about the interactions between genotype and environment. There are, however, a number of devices by which environmental variation is reduced and the heritability and rate of progress by selection consequently increased. For dairy cattle, there are indications that heritability is greater in high-yielding than in low-yielding herds.

Not surprisingly, most of the genetic improvements which can to date be attributed to progeny testing are reported in pigs and poultry, the latter, especially, having been found very suitable material for progeny testing. This is because of their fecundity, relatively short generation interval, and because their most desired characters—egg production in the one case, carcass quality in the other—are sex-limited (poultry) or only measurable after slaughter (pigs). In poultry, trap-nesting, because of its cost, is tending to be replaced by hen-house averages on random samples of progeny. Records based on only part of the laying year are tending to replace full-year records because the slightly lesser accuracy of the former is outweighed by greater total progress due to the shortened generation interval.

A special application of the progeny test is to discover carriers of undesirable recessive genes. For this purpose, three methods are available : to mate the male to known recessive females ; to mate him to known heterozygotes ; to mate him with his own daughters. As soon

as a single recessive appears among the progeny, the heterozygosity of the sire is demonstrated (that is, he is a " carrier "). If one is prepared to allow one heterozygous male in twenty to pass the test unnoticed, then the numbers of progeny required in each of the three methods outlined are 5, 11 and 23 respectively. Practical considerations will determine the level of probability required and the method to use. Obviously, when testing for a lethal the first of the three methods cannot be used.

From the papers reviewed here, it becomes clear that no useful purpose is served by progeny testing unless the data are correctly interpreted and the results efficiently used. The greatest hindrance to interpretation has been a confounding of genetic with environmental correlations, and often only little use has been made of the results because the animals showing up best on the test are eliminated on other criteria.

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G.W.
H.P.D.

ANIMAL NUTRITION

Possible Digestive Disorders with Fodder Beet

Where the pig is concerned, fodder beet is introduced gradually into the ration by the Lehmann system, so that there is ample opportunity for the animal to become accustomed to it. In any case, the digestive agents in the simple alimentary system are mainly enzymes secreted in the digestive fluids. Upsets are therefore rare in the pig, and bad scouring (apart from the soft faeces normally associated with beet feeding) occurs only when the beets are dirty or frost damaged, or suddenly introduced into the diet, or when a variety with too low a dry matter is used.

The ruminant, however, is held to ransom by the need to consider the delicate balance of ruminal micro-organisms, because any sudden dietary change which throws the workings of these out of gear can be disastrous. In one case [1] fodder beet was spread liberally on a field in late April

without previously accustoming the herd to it, and the whole herd was affected with symptoms similar to those of milk fever. It was thought that an average of 40 lb. of this new food had been consumed per head, and the dry matter was found to be excessively high due to drying out. Blood calcium was low in the affected animals and treatment was by calcium borogluconate, but in spite of this there were six deaths. No toxic agents could be detected in the beets. In another case [2] a single cow died after breaking into a beet clamp in November ; again blood calcium was low. In all the dead animals the rumen lining was inflamed.

It is necessary to emphasize, however, that when properly fed (that is, introduced by gradual change-over, and increased gradually thereafter) very large amounts can often be taken with impunity. Thus an average of 80 lb. per day was fed to four cows of 12-13 cwt. live weight for a week without any trouble [3] ; normally, about 30 lb. of fodder beet containing 18 or 19 per cent dry matter would be sufficient per day for the average cow.

An interesting account of how fodder beet and its by-products, and other succulent bulky foods, can be used to feed pigs during the major part of the year, is given in the report of the 1952 Proceedings of the British Veterinary Association Conference [4].

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S.M.B.

CROP HUSBANDRY

Artificial Ripening of Seed Crops

The possibilities of speeding up ripening of farm plants by means of chemicals have been investigated in Denmark, and preliminary work conducted in 1953 has been reported (*Ugeskrift for Landmaend* 1954, **22**). Three of the substances used were : Calcium chlorate, which resembles sodium chlorate in its action but which is not inflammable and can only be used on annual crops or on crops which are to be ploughed in after harvest ; Monochlorideacetate, which is non-poisonous ; and DNBP, which is poisonous and consequently unsuitable for the drying of seed crops for human consumption.

The general conclusions from these preliminary, one-year trials, were that the use of chemical preparations for the maturing of cereals had

no practical importance. Spraying assisted the ripening of seed crops of winter rape and white mustard, but DNBP had a harmful effect upon the germinating ability of the seed. In red clover and white clover, spraying resulted in a considerable reduction in water content of the seed without a corresponding deterioration in grain weight or germination capacity. DNBP gave the best results. Further work is contemplated.

Potatoes

Boyd and Lessells report on the effect of seed rate on the yield of potatoes (*J. agric. Sci.*, 1954, **44**, 465-76) in a paper which forms part of a detailed investigation of the crop. They examined in detail a number of recent experiments and used data from the large scale survey of maincrop potatoes which was conducted in 1950. They say that there is a close relationship between the weight of seed planted and yield, and that it is of secondary importance whether the variation in seed rate arises from changes in tuber size or spacing between tubers. In other words, it is the weight of seed planted, practically regardless of the size of set or spacing between sets, which determines the yield of ware. Provided the grower " can modify the spacing distance between tubers, the average size of tuber in the seed he purchases is of little importance ; in recent years there have been many complaints from growers about the large size of much of the seed coming from Scotland, but the results just described suggest that this may not be a great disadvantage provided the grower can increase his planting distance to correspond with the greater set size. It also implies that, when sowing chats instead of ware, the same weight per acre should be sown by reducing spacing."

The authors compute that in 1952 the optimum rate of planting certified seed was 16-17 cwt. per acre. For a grower's own once grown seed, for which the cost is not more than the price received for ware, the optimum seed rate was at least one ton per acre. The average weight of a tuber of certified seed in 1950 was almost 2½ ounces, compared with just over 2 oz. for the average, once-grown set. They estimate that the average loss per acre due to failure to plant at the optimum seed rate amounted to 20-25s. per acre planted with certified seed, and 10-15s. per acre for once-grown seed.

Proctor Barley

It is reported that the Barley Advisory Committee of the Institute of Brewing has recently organized malting and brewing trials of Proctor barley (*J. Inst. Brew.* 1954, **60**, 284-5). Four breweries undertook trials of the barley from the 1953 crop against a control of Spratt Archer from the same crop. The general consensus of opinion was that the Proctor barley was very close to the control in malting characteristics and in the quality of the malt produced. Tasters at three centres showed a slight preference for the Proctor beer, and at two other centres tasters considered it rather harsher than the Spratt Archer beer. The Barley Advisory Committee considers that these preliminary trials

" indicate that there is reason to suppose that Proctor barley is at least comparable in its malting and brewing qualities with the traditional malting varieties such as Spratt- and Plumage-Archer."

Wild Oats

A. F. Wiese and R. S. Dunham of the University of Minnesota (*Agron. J.* 1954, **46,** 358-60) state that according to reports from numerous workers, pre-planting, pre-emergence and post-emergence applications of IPC (isopropyl N-phenylcarbamate) and CIPC (isopropyl-N-(3-chlorophenyl) carbamate) have not been successful because concentrations high enough to control wild oats (*Avena fatua*) severely injured the crops. The authors themselves investigated the possibility of autumn applications of IPC and CIPC (5, 10 and 15 lb. per acre) killing wild oats yet being dissipated in the spring before small grains are normally sown. They found that treatments not toxic to cultivated oats at sowing time only partly controlled wild oats. Wild oats were eliminated only in treatments where CIPC and IPC were very toxic to cultivated oats sown in the spring. They found in a laboratory investigation that, so far from breaking the dormancy of wild oats, soaking in solutions of CIPC induced secondary dormancy.

D. H. R.

GLASSHOUSE CROPS

Tomatoes : " Cloud " or Vascular Browning

I. Conditions affecting the incidence of " Cloud ". E. B. Kidson and D. J. Stanton, Cawthron Institute, Nelson. *New Zealand J. of Science & Technology*, 1953, Sec. A, **34,** No. 6, April.
II. Some chemical characteristics of plant and soil in relation to susceptibility to " Cloud ". E. B. Kidson and D. J. Stanton, Cawthron Institute, Nelson. *New Zealand J. of Science & Technology*, 1953, Sec. A, **35,** No. 1, June.

The first-named author visited this country in 1954, and confirms that the disorder in tomatoes in New Zealand called " Cloud " is identical with the trouble encountered in the U.K., and called " blotchy ripening " (An account of the researches carried out at Cheshunt into the cause of this disorder was given in No. 7 of this Review). The New Zealand workers report (in I), that " cloud " in glasshouse fruit has been increased by soil sterilization, heavy watering, raw organic manures, glucose, heavy defoliation, and the opposite extreme—excess leaf growth. It has been decreased by light watering, by very heavy dressings of potash during the winter and by the frequent applications of nitrogenous fertilizers, muriate of potash or calcium chloride throughout the season. The beneficial treatments tended to produce a thinner-stemmed, less rank type of growth and a slightly reduced weight of fruit per plant. In II, the work on the chemical aspects is described,

and " cloud " has been found to be associated with a low dry-matter content of the fruit and leaves. Treatments which increase cloud have been shown to decrease the dry-matter in the fruit and leaves, and vice versa. The tentative conclusion is drawn that cloud is the result of an abnormally low content of organic matter in the fruit, and may be due either to an excessive water uptake or to reduced photosynthesis under reduced light or to both these causes. The authors also suggest that the beneficial effect of heavy dressings of potash and nitrogenous fertilizers may be due to their effect on water uptake by the plant.

Among suggestions for controlling the trouble, they mention careful regulation of the water supply as the first essential. Where the heavy type of growth usually associated with cloud is appearing, steps should be taken to reduce watering, to accelerate loss of moisture from the soil and to steady the growth by any other possible means. Under weather conditions conducive to cloud, the use of extra mineral fertilizers, such as potash and inorganic nitrogen compounds, may be the most effective method of reducing susceptibility to the disorder. All corrective measures should be used with care, as they may lead to the formation of blossom end rot and other symptoms of water shortage.

Some Preliminary Observations on the Growth Inter-Relations of Roots and Tops of Glasshouse Tomatoes. E. R. Leonard. Experimental & Research Station, Cheshunt. *Report of XIIIth International Horticultural Congress*, 1952 ; 885.

Much research has been carried out on the growth of the aerial portion of the plant in relation to light and temperature, and their interaction, but comparatively little quantitative data on the root are available. A preliminary survey of the root distribution of plants of Potentate growing in a steam sterilized glasshouse border (medium loam overlying gravel) revealed that, under the prevailing cultural conditions, roots extended to a depth of 2 ft. 8 in., and occupied fairly completely the ground between adjacent rows of plants. In addition to observations in the glass-lined trench, measurements were also made from plants growing in a glass-sided box. The cultural operations, including application of water and fertilizers, followed normal commercial practice for the variety.

In addition to observations on length of stem, development and number of leaves, trusses, etc., it was found that the roots showed four consecutive phases of growth. (*a*) A rapid rise to a peak value (at about the end of May), followed by (*b*) a marked decline. There is then (*c*) a gradual rise with short term fluctuations to (*d*) a new sustained high level towards the end of the season in the thinner roots, but a continued decline in the thicker ones. The peak of root development between phases (*a*) and (*b*) is associated with the setting of the first fruit trusses and the recovery phase (*c*) with the harvesting of the fruit from the lower trusses.

E. S.

FLOWERS

Propagation by Seedage and Grafting under Fluorescent Lamps. V. T. Stoutemyer and A. W. Close. *Proc. Amer. Soc. Hort. Sci.* 1953, **62,** 459-65.

Experiments were made to compare the relative ease of transplanting of seedlings grown under various light sources and to test these sources for the grafting of coniferous and broad-leaved evergreens.

The trials were carried out in a dark shed with the temperature kept between 60° and 65°F. during the winter and slightly higher in summer. Seeds were sown on sphagnum and pricked out at an early stage in seed-boxes containing a compost approximating to J.I.P. The light sources were all various types of 40-watt fluorescent tubes in standard double fixtures with industrial type reflectors, and kept as close to the seedlings as practicable—in no case more than one foot distant. The lighting period was in all cases 16 hours. Before planting out seedlings were hardened outside. Control plants were raised in a glasshouse under conditions usual for the particular plant. A wide range of plants was tried, including cabbage, tomato, peppers and many flowering annuals.

The light sources used were pink, green, gold, blue, daylight, soft white, and 3500°K. white (a somewhat yellowish white), alone and in various combinations. Pink tubes alone tended to produce soft growth and blue alone weaker growth. Green or gold tubes had no particular usefulness. In general, blue plus 3500°K. white tubes and daylight tubes produced the best results, often equal or superior to normally grown plants. The soft white and daylight plus 3500°K. tubes produced softer plants which often survived less well on planting out.

In the grafting experiments, side grafts of hemlock (*Tsuga*), Colorado blue spruce and hybrid rhododendron were made, tied with rubber bands and placed in a storage pit, several inches below double 40-watt 3500°K. white fluorescent tubes in standard industrial type reflectors. The pots and unions were covered with three different moist materials ; shredded sphagnum, moss peat and vermiculite. Soil-heating cables kept the bench temperature between 70° and 75°F., with the air temperature about 10° lower. The grafting was done on April 17 and the grafts received no attention until May 21. Sixteen hours of lighting daily were given. All the grafts in the moss peat took well, as did nearly all those in sphagnum. Vermiculite appeared to retain too much water and results were less good. The experiments, though on a small scale, showed that the method has promise for such notoriously difficult subjects as blue spruce.

The Effect of Various Nutrient Intensities on Growth and Development of Snapdragons (Antirrhinum Majus L.). H. L. Flint and S. Asen. *Proc. Amer. Soc. Hort. Sci.* 1953, **62,** 481-6.

In the U.S.A., antirrhinums grown in glasshouses following a crop of chrysanthemums, without leaching of soluble fertilizers from the soil, often show serious injury. This has led to the belief that the salt tolerance of the antirrhinum is lower than that of other crops.

Two varieties of antirrhinum, an inbred white and a hybrid pink, were grown in sand culture with nutrient solutions of five different concentrations : normal, quarter-normal, half-normal, twice normal and four times normal. These solutions had calculated osmotic pressures from the weakest to the strongest, of 0.19, 0.38, 0.73, 1.46 and 2.78 atmospheres. The three lower concentrations produced good plants which showed few differences, except that more lateral branching occurred with the 0.38 and 0.73 atm. solutions. Nutrient concentrations greater than 0.73 atmosphere caused chlorosis, fading of flower colour, abnormal flower carriage, fewer flowers, decreased dry matter production, and shorter and weaker stems.

Since many plants thrive with nutrient solutions considerably more concentrated than that producing optimum results in these experiments, it is clear that the antirrhinum has, indeed, an abnormally low salt tolerance and care is necessary in preparing composts to ensure that the soluble salt content is not too high.

Gerberia* Jamesoni. I.—A Study of Flower Production and Quality at Several pH Values. R. F. Stinson. *Proc. Amer. Soc. Hort. Sci.*, 1953. **62,** 487-90.

Gerbera plants were grown in a fine sandy loam with a natural *p*H of 5.5, which was adjusted by use of aluminium sulphate or hydrated lime to values within the ranges 4.0-5.0, 5.0-6.0, 6.0-7.0, and 7.0-8.0. It was not possible to control the *p*H accurately, but over the greater part of the season the values were well within the ranges specified. Planting was done in June and records of flower production were taken from August to May. No significant differences in production were found between the three higher *p*H values (approximately 32 flowers per plant), but in the most acid soil, *p*H 4.0-5.0, a significant reduction occurred (19.3 flowers per plant). Flower diameter was not significantly different in any of the soils but stem length was slightly reduced in the most acid soil.

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*The author retains the old spelling *Gerberia : Gerbera* (nom. conserv.) is correct according to the latest Rules of Botanical Nomenclature.

NUTRITION OF HORTICULTURAL CROPS

Zinc Deficiency of Fruit Trees in Great Britain. C. Bould, D. J. D. Nicholas, J. A. H. Tolhurst and J. M. S. Potter. *J. hort. Sci.*, 1953. **28.** 260-7.

The diagnosis and correction of zinc deficiency in fruit trees growing in the Royal Horticultural Society's Gardens, Wisley, are described and illustrated. The site is low lying and the soil is a medium coarse sand and gravel overlying deep gravel. In 1948 the *p*H of the profile decreased with depth from 7.2 to 6.8. Liberal dressings of potassium sulphate and hoof-and-horn meal had been given to the orchard for many years.

Zinc deficiency in apples is identified by leaf symptoms and rosetting due to short intervenal growth. Affected leaves are lanceolate, with wavy margins and diffuse intervenal chlorosis. Fruits from the affected spurs are small and the symptoms may be more pronounced on one branch than another.

The symptoms in pears are not so distinct. Leaves are reduced in size but marginal waviness is absent. Both apple and pear trees suffering from zinc deficiency become stunted and show little extension growth.

Leaves deficient in zinc contain less than 10 p.p.m. zinc; severely affected leaves contain less than 5 p.p.m. zinc.

Zinc deficiency was corrected by foliage sprays of 0.1 per cent zinc sulphate at petal fall, or by 5 per cent zinc sulphate sprays during the dormant season.

Apple varieties growing on Malling Nos. I, II and XII showed varying susceptibility to the deficiency. In the same way some varieties were more sensitive to the zinc sprays than others.

Copper Deficiency of Fruit Trees in Great Britain. C. Bould, D. J. D. Nicholas, J. A. H. Tolhurst and J. M. S. Potter. *J. hort. Sci.* 1953, **28,** 268-77.

During the correction of zinc deficiency at Wisley Gardens, symptoms of copper deficiency in the same fruit gardens were observed. The symptoms of copper deficiency in apples and pears are fully illustrated.

The first symptoms of the deficiency in the apple occur in the terminal leaves of current year shoots in early July. The leaves show necrotic areas accompanied by upward curling and distortion of the leaf. Later in July, defoliation of the shoot occurs in the upper part; the shoot gradually withers and dies giving rise to the names "wither tip" and summer "die-back." Old trees which become affected show rough and deeply fissured bark.

In the pear, the current year's growth is similarly affected and characteristic die-back of shoots occurs.

Copper deficiency was corrected by the following different uses of copper sulphate. Addition to the soil at the rate of $\frac{1}{2}$ lb. per tree; application of 4 per cent dormant spray; application of 0.05 per cent foliage spray; and lastly branch or trunk injections.

Spray applied in the dormant period caused no damage to the tree ; foliage sprays were used with a wetting agent and gave a quick correction of the deficiency only when applied before the death of the growing point.

The improvement in growth due to copper treatment was not necessarily accompanied by an increase in copper content of the foliage. However, in apple and pear leaves, the threshold copper level associated with the onset of visual symptoms, is anything from 5 p.p.m. copper or less, in the leaf dry matter.

Tests on available copper in the soil using Aspergillus niger showed that soils providing adequate copper for fruit trees give values of 2 p.p.m. of available copper, or more, per gm. of air-dry soil.

Chemical Composition of Cortland Apple Leaves in relation to Nutritional Treatment. C. A. Eaves and A. Kelsall, *J. Hort Sci.*, 1954. **29.** 59-71.

Orchards in the Annapolis Valley of Nova Scotia are situated on sandy loams of low fertility and with a soil reaction of *p*H 5.0. Fertilizer treatments consisted of NPK fertilizers and dolomitic limestone.

Severe magnesium deficiency showed in the unlimed blocks in the year with higher rainfall. The content of magnesium fell to 0.17 per cent of the leaf dry matter. Slight potassium deficiency appeared in trees receiving lime and nitrogen only. In the year with the highest rainfall, the magnesium leaf-content fell by 35 per cent, while the phosphorus and potassium increased by 20 per cent.

The authors suggest that magnesium deficiency in apples is due to high levels of potassium or phosphorus. On the other hand, nitrogen applications reduce the severity of magnesium deficiency due to the lower intake of phosphate and potassium ions.

Although dolomitic limestone is considered to be efficacious in correcting magnesium deficiency symptoms, a warning is given about the inducement of corky core, particularly in Cortland apples, which are sensitive to boron deficiency.

W.P.

DAIRY HUSBANDRY

Grazing Behaviour

Whilst most stockmen have views on the behaviour of cattle at grass, the amount of precise evidence concerning it is scanty. Hancock (*J. Agr. Sci.* 1954, **44,** 420) has reported on observations carried out over 24 hours on several occasions during the grazing season on 10 sets of monozygous twins. For all observations on all twins the following average times per 24 hours were recorded :

Grazing	503 minutes
Ruminating	413 minutes
Resting (lying down not ruminating) ..	259 minutes
Idling (standing or walking, not grazing or ruminating)	265 minutes

While weather had no orderly influence on these various activities, both quantity and quality of sward had a pronounced effect. Grazing time was short when the herbage was abundant and of high quality; it was longer when abundant but of lower quality; and was longest of all when the grass was short irrespective of quality. At all stages of the lactation a positive correlation between grazing time and yield was established, although differences in growth rate between twins reduced the consistency of this correlation. Ruminating time was shown to increase in a regular manner with increasing intake of dry matter but was increased also by higher crude fibre in the dry matter. Characteristic differences in ruminating time were also found between different animals.

Production Per Acre

Included with the valuable statistical data on the New Zealand dairy industry presented in the 29th Annual Report of the Dairy Board (N.Z. Dairy Board, 1953, 29th Annual Report) is much interesting information on various aspects of dairy husbandry. In New Zealand, survey results and field experiment results are usually quoted in weight of butterfat per acre or weight of butterfat per cow, and by British standards the output of butterfat per acre is often very high. The report, however, draws attention to the fact that even in that country there is a substantial difference between the actual butterfat output per acre of the average farm and the potential output. Thus, while it is estimated that on the better class of dairying land an output of 400 lb. of butterfat per acre from grass alone could be obtained and, in fact, occasionally is obtained, a large scale survey of 1,827 herds, regarded as well above average, revealed no more than 8 per cent with an output of over 250 lb. butterfat per acre.

Amongst a number of variables studied, the output of milk and butterfat per acre from Friesian and Jersey cattle was investigated. In 35 herds of each breed kept under fairly comparable conditions the following data were obtained :

	Friesians	Jerseys
	lb.	*lb.*
Average milk per cow	7,880	5,900
Average fat test per cent	3.74	5.12
Average fat yield	295	302
Average milk per acre	3,410	3,360
Average fat per acre	128	172

Although the data are too few and the comparison, of necessity, not very precise, it seems that under New Zealand conditions, while there may be little to choose between the two breeds as regards output of milk per acre, the Jersey is likely to produce substantially more fat per acre than the Friesian.

Milking Method

Further studies of the effect of vacuum level and of duration of milking on milking efficiency have been carried out in Connecticut (A. T. Gregoire, R. D. Mochrie, F. I. Elliott, H. D. Eaton, A. A. Spielman and G. Beall. *J. Dairy Sci.*, 1954, **37,** 276). Comparing vacuum levels of 10, 13 and 17 in. of mercury, no differences in yield or fat content could be demonstrated. Rate of milk flow increased with increasing vacuum level but the amount of strippings was lowest when milking at the 13-in. level. Leaving the teat cups on for a period twice as long as necessary for a normal milking slightly increased both yield of milk and rate of milking but had no effect on the fat content of the milk.

In investigating milking technique, injections of oxytocin are frequently used to bring about the ejection of milk. There has, however, been little evidence concerning the long term effect of the persistent use of this hormone to promote udder evacuation. In a recent experiment in Wisconsin (D. G. Sprain, V. R. Smith, W. J. Tyler and O. T. Fosgate. *J. Dairy Sci.*, 1954, **37,** 195), seven cows were milked under experimental control throughout a lactation, during which for alternating fortnights they were milked either normally or following an intrajugular injection of 10 I.U. oxytocin immediately before each milking. Comparison of yields between experimental fortnights and control fortnights for the whole lactation revealed an increase in milk production in all seven cows amounting on average to 3.6 lb. per cow daily when injected. A slightly higher fat percentage recorded in the milkings following injection, compared with control milkings, was not significant. While there is no suggestion that oxytocin should be used in commercial production the work suggests that in normal circumstances physiological factors associated with the ejection or " let down " of milk may be partially responsible for limiting milk production.

Milk Fever

While treatment of milk fever when it occurs is common veterinary practice, less is known about its prevention. For example, advice on the feeding of minerals during pregnancy with a view to checking milk fever not infrequently includes the provision of a mineral mixture with a high calcium content. Recent work in California (J. M. Boda and H. H. Cole. *J. Dairy Sci.*, 1954, **37,** 360) suggests that this latter advice may, in fact, be very unsound. In this work diets with varying contents of calcium and phosphorus were fed to sixty-nine older Jersey cows in the later stages of pregnancy and the incidence of milk fever and blood levels of calcium and phosphorus were studied at and after parturition. There appeared to be a direct relationship between the calcium : phosphorus ratio and the incidence of milk fever. Thus, with a calcium : phosphorus ratio of 6 : 1 clinical symptoms occurred in 30 per cent of the animals, while when the ratio was 1 : 3.3 no cases occurred. It was suggested that the low-calcium high-phosphorus diet in pregnancy induced a hypertrophy of the parathyroid glands which helped to avert a drop in serum calcium at and after calving.

Milk Quality

Further evidence on the fall in fat content of milk due to diets low in hay and high in concentrates has been put forward by workers at Shinfield (C. C. Balch, D. A. Balch, S. Bartlett, C. P. Cox, S. J. Rowland and J. Turner. *J. Dairy Res.*, 1954, **21,** 165; C. C. Balch, D. A. Balch, S. Bartlett, Z. D. Hosking, V. W. Johnson, S. J. Rowland and J. Turner. *J. Dairy Sci.*, 1954, **21,** 172). In the first experiment reported, where the ration of hay was reduced from 18 to 4 lb. per head daily and concentrates (containing a large proportion of flaked maize) increased by 6 lb. per head daily, the fat percentage of the milk was reduced by about 0.7 per cent, and this occurred when the concentrates were high in protein (22.3 per cent Cr. protein) or low in protein (11.6 per cent Cr. protein).

In the second experiment, where the hay ration was reduced from 16 to 12 lb. per head daily no change in fat percentage was observed, but when it was reduced to 8 lb. or 4 lb. per head daily the percentage was decreased by about 1.1 per cent. When the 8 lb. of hay was ground in a hammer mill the decrease in fat percentage was enhanced and amounted to 1.72 per cent, indicating that physical characteristics of the hay, as well as the proportion present, affected the fat content of the milk. There was evidence that the effect on milk quality of the low hay/high concentrate diet diminished with advancing lactation.

Calf Feeding

A number of further reports concerning the effect of antibiotics in the diet of the calf have appeared. (E. E. Bartley, F. C. Fountaine, F. W. Atkeson and H. C. Fryer. *J. Dairy Sci.*, 1954, **37,** 982; L. L. Rusoff, J. M. Fussell, C. E. Hyde and R. M. Crown. *J. Dairy Sci.*, 1954, **37,** 488; J. W. Hibbs, H. R. Conrad and W. D. Pounden. *J. Dairy Sci.*, 1954, **37,** 724). In Kansas the feeding of either 45 mg. or 90 mg. aureomycin per 100 lb. body weight reduced infection and substantially improved growth rate from birth to 12 weeks and also from 12 to 25 weeks old, although the suggestion is put forward that the high levels of aureomycin (45 mg. per 100 lb. liveweight) are more effective before 12 weeks old while a lower level (15 mg.) is preferable from 12 to 25 weeks. In Louisiana, the intramuscular injection of 400 mg. aureomycin once weekly improved growth by about 30 per cent up to 16 weeks old, while 50-90 mg. daily, given orally, improved growth by about 20 per cent. In Ohio, 15 mg. aureomycin per calf daily for the first seven weeks followed by 20 mg. per pound of concentrates consumed, resulted in a rate of liveweight gain about 25 per cent greater than controls receiving no aureomycin. When, however, the aureomycin was withdrawn at 12 weeks old, the control calves grew somewhat faster than those which had received the aureomycin and as a result the mean weight of the two groups was about the same at 26 weeks old. Thus, while there is now extensive evidence that aureomycin can have a substantial effect in reducing infection and increasing growth rate in calves under 12 weeks old, no general conclusion can yet be reached on its effect at later stages of growth.

The present low price of dried skim milk powder has drawn attention to the use of reconstituted milk for young calves instead of expensive whole milk. Amongst other problems the question of the need to add fat and also that of additional minerals frequently arises. A recent paper from Cornell University (H. M. Cunningham and J. K. Loosli. *J. Dairy Sci.*, 1954, **37,** 453) provides evidence that, while the body storage of essential fatty acids at birth may be sufficient to carry the calf through the milk feeding stage, a small percentage of dietary fat, perhaps 1 to 2 per cent, is necessary. This quantity might, of course, be present in the dried skim milk powder or in the carbohydrate food usually included in whole milk substitutes ; the essential rôle of this small quantity of fat should however be kept in mind. The haemoglobin levels in the blood of calves reared on the U.S.D.A. farms at Beltsville have been studied over a number of years (J. W. Thomas, M. Okamoto, W. C. Jacobson and L. A. Moore. *J. Dairy Sci.*, 1954, **37,** 805). In some circumstances the levels of haemoglobin were substantially subnormal and marked response to administration of iron was recorded. In one herd the haemoglobin level was correlated with the rate of liveweight gain. While it seems unlikely that iron would be sufficiently low in a milk substitute based on dried skim milk powder and cereals, the importance of iron in the nutrition of the calf, feeding mainly on milk products, must not be ignored.

A.S.F.

MYCOLOGY

Potato Blight

Potato Spraying Trials in Yorkshire 1947-51. A. Beaumont, J. H. Bant and I. F. Storey. *Plant Pathology*, 1953, **2,** 56-60.

The object of these trials was to assess the economic value of preventative spraying against Potato Blight in the Goole district, an important potato growing area and one in which blight appears earliest in Yorkshire. The variety sprayed was Majestic and the treatments were (1) unsprayed control ; (2) one spraying end of July ; (3) two sprayings, end of July and three weeks later. The spray material used was 4 : 5 : 40 Bordeaux mixture. Blight did not usually appear before early August and in most years developed slowly. The exceptional year was 1950 when blight had reached 50 per cent kill on B.M.S. scale by end of August and this was the only year in which the twice sprayed plots died later than those receiving one spray. There was no increase in yield due to spraying in 1947, 1949 and 1951. In 1948 the gain from both one and two applications was approximately 1 ton (9 per cent increase in yield) and in 1950 two sprayings increased yield by about 2 tons (18 per cent of increase in yield) and one spraying gave an increase of 1 ton.

Over the five years the total gain from spraying was only just sufficient to cover the cost. Therefore, allowing for tractor wheel injury to the tops with commercial spraying and some risk of spray damage in dry years, routine spraying cannot be recommended in this area.

Spraying Trials in the Potato-growing Area around the Wash, 1948-53. E. C. Large, R. Eric Taylor, I. F. Storey and A. H. Yule. *Plant Pathology*, 1954, **3**, 40-8.

These trials at Terrington St. Clement Experimental Farm were carried out in the potato growing area where blight appears earlier and progresses more rapidly than elsewhere in eastern England. The variety King Edward was used each year and Majestic was also included in the last three years. The treatments were : (1) Wet spraying with a 13 row tractor drawn machine with drop lances applying 6 lb. copper oxychloride preparation in 100 galls. water per acre ; (2) Atomizing with a 13 row Agro machine with air blast nozzles on drop legs, applying 6 lb. copper oxychloride in 15 gallons water per acre (except in 1953 when top spraying only was substituted) ; (3) Dry dusting with 11 row duster applying about 25 lb. copper lime dust per acre ; (4) Untreated control.

In 1948 and 1949 two wet sprayings were compared with four applications of dust, and in the other years three sprayings were compared with six dustings. There were four replicates of each treatment except in 1948 when there were five. Yields were recorded from one row in which tractor wheels had passed and from two undamaged rows so that it was possible to estimate the loss of crop due to mechanical damage and to calculate the net losses and gains due to spraying and dusting. On the variety King Edward there was a net gain from high volume spraying and atomizing of about 1 ton per acre in 1948, 3 tons in 1950 and $2\frac{1}{2}$ tons in 1953. In 1949 and 1952, when no blight was present on the plots, there was a net loss from these treatments of 2 tons per acre possibly due to copper injury as well as wheel damage. In 1951 there was neither gain nor loss. Dry dusting was less effective than spraying except in 1949. Results for the variety Majestic were similar. Reasonably accurate estimates of the effect of spraying were possible from the progress curves for blight on sprayed and unsprayed plots.

From these trials and previous observations it is concluded that the spraying of King Edward is an economic proposition in this area. It is suggested that still better results could be obtained by delaying the first spraying until the end of the last week in July, and deferring the second spraying until blight outbreaks have been seen or forecasted in the area.

Potato Blight Forecasting Investigation in England and Wales, 1950-52. Compiled by E. C. Large—*Plant Pathology*, 1953, **2**, 1-14.

The object of these investigations was to determine how far meteorological observations could be used as a basis for issuing warnings of the

imminence of potato blight outbreaks. Some forty synoptic meteorological stations co-operated by notifying the Provincial Plant Pathologists in their districts of " Beaumont Periods " ; that is periods of not less than 48 hours with a minimum temperature of 50°F. and a relative humidity not less than 75 per cent. First outbreaks of blight recorded by the plant pathologists were plotted on a time scale against the critical periods noted at the nearest weather stations. In the " blight " year of 1950 critical meteorological periods at the majority of the stations preceded outbreaks of blight in their areas by 7-21 days. In 1951, when blight started a month later in most areas, forecasting was not so generally successful due to the absence of critical periods in the midland and eastern areas. In 1952, it was decided to explore a method in which regional forecasts could be based on a network of stations rather than relying on individual stations. In this year blight appeared late except in the west and the Beaumont Periods from the network of stations gave a good indication of the outbreaks of blight in most zones. The investigation is continuing and further modifications of the methods are being studied.

Susceptibility of Immature Potato Tubers to Blight. A. E. W. Boyd and J. Margaret Henderson. *Plant Pathology*, 1953, **2**, 113-6.

In samples of Doon Star potato tubers lifted at weekly intervals from August 9 to September 26, it was found that the maximum development of blight occurred in tubers lifted on August 21, though infection on the tops was 5 per cent or less. Similar results had been obtained in previous trials. Experiments were made in which healthy tubers of Doon Star, Golden Wonder and King Edward were lifted at weekly intervals and sprayed with a spore suspension of *Phytophthora infestans*. The results showed a decrease in susceptibility with lifting dates after August 16 until September 27 when no infection occurred. To eliminate the factor of resistance due to increase of skin thickness, cut slices of the tubers were also inoculated. With King Edward, resistance of the tissue to infection increased throughout the season, but with the other varieties there was a slight tendency or resistance to increase with tuber maturity until near the end of the season and then to decrease again.

Delayed Sporulation of *Phytophthora infestans* on Infected Potato Shoots. Margaret A. Keay. *Plant Pathology*, 1953, **2**, 68-70.

In experiments with the varieties King Edward and Canso, blight infected tubers were planted in sterile soil and kept in greenhouses or cold frames or isolated in the open. Some of the plants showed stem necrosis 30-39 days after planting but no spores of *Phytophthora infestans* were produced until the affected portions were placed in a humid atmosphere. Some plants with necrotic lesions were kept for up to $4\frac{1}{2}$ months without producing fructifications but then produced sporangiophores when placed in warm damp conditions. Similar results obtained with King Edward plants artificially inoculated in the stems confirmed that *Phytophthora infestans* may persist in potato stems for long periods without sporulating. H. E. C.

COMMONWEALTH AGRICULTURAL BUREAUX PUBLICATIONS

Bureau of Animal Breeding and Genetics

Estimation of Live Weight of Cattle. A problem which frequently faces the breeder or research worker, who for some reason has not all the facilities he needs for his work, is that of calculating the live weight of his animals. There are a number of formulae for this, but not all can be applied to every type of cattle. These formulae are usually based on the linear relationship of heart girth to live weight, since, of all body measurements, heart girth has the closest affinity to live weight. This relationship varies according to the age and condition of the animal. The value of the formulae also depends largely upon the accuracy of the girth measurements.

Recently a paper " Sambandet mellan vissa Rroppsmått och Levande resp. Slaktad Vikt hos Nötkreatur (The Relationship between certain Body Measurements and Live and Slaughter Weight in Cattle) ", by I. Johansson and S. E. Hildeman, summarizing the findings of various people on this relationship, was published in the Swedish journal *Kungliga Lantbruksakademiens Tidskrift* (**92,** 273-305). In view of its general interest to those engaged in research and advisory work, the paper was translated and published as a review in *Animal Breeding Abstracts*, Volume 22, No. 1 (March 1954). Its particular value to readers of the *N.A.A.S Quarterly Review* is that it gives values for the average live weight of animals having a range of heart girth from 120 to 220 cm. and for three types of condition—high, normal and low. The table can therefore be used to estimate the live weight of individual animals or of a group of cattle whose mean heart girth is known, and could be of great help in calculating their food requirements.

Recent developments in every field of animal breeding are covered by the abstract section of the journal, so that progress in, say, A.I. technique or in progeny testing, can be followed by reference to the appropriate section.

Dog Genetics. Information on particular aspects of breeding is also given by the bureau in other publications. In *The Genetics of the Dog*, Marca Burns has related a great deal of the scientific work on inheritance to present-day dog breeding in a form which is both lucid and informative. The book, which is illustrated and has a useful bibliography, costs 12s. 6d.

Bureau of Animal Nutrition

Effects of Thiouracil. By its action on the thyroid gland methylthiouracil reduces thyroxin production and so lowers an animal's metabolism rate and reduces its maintenance requirements. Experiments reported recently from Denmark showed that cattle fattened for the butcher that were given thiouracil were heavier at slaughter and looked fatter than those not given thiouracil, and, when sold, bullocks fetched a higher price per kg. Part of the excess weight was in stomach contents. Analysis showed that the fat of the meat was reduced and,

from the analytical data as published it may be computed that the mean difference in carcass weight between two groups of cows, one treated and the other untreated, was in their water content. (*Nutrition Abstracts and Reviews*, **24,** Abstract 2485.)

Research using Monozygotic Twins. At Ruakura Animal Research Station in New Zealand studies of monozygotic cattle twins have continued for a number of years. This type of research makes relatively rapid progress because genetic variables are held constant and the effects of environment may more easily be analysed. Recent studies in which access to grazing and supplements to grazing were controlled and concentrates were given or withheld, showed that, within the limits of the differences imposed, milk yield was fixed nine-tenths by heredity and modified only one-tenth by intensity of feeding. Differences between twins induced by experimental underfeeding are soon removed and new experiments can be made. Steaming up for a month before calving gave heavier calves, 10 per cent more milk, and 11 per cent more butterfat during the first 3 months of lactation. (*Nutrition Abstracts and Reviews*, **24,** Abstract 2496.)

Fat Content of Concentrates. The subject of the fat content of concentrates for dairy cows continues unsettled. Two sets of data derived from similar experiments, made in Denmark and U.S.A. with expeller and solvent extraction linseed meals, have recently been published. A control group of cows in the Danish experiment were given whole linseed. The amount of 4 per cent fat corrected milk produced by the Danish cows varied directly with the fat content of the concentrate used; the yield from the cows in America was unaffected by the difference in oil content. Conflicting results like these must be disconcerting to advisory officers. It is of interest that almost complete removal of oil from the linseed did not prevent its conditioning effect. A review of the literature on the subject is being prepared at the Commonwealth Bureau of Animal Nutrition. (*Nutrition Abstracts and Reviews*, **24,** Abstract 2500.)

Bureau of Dairy Science

Recent review articles from **Dairy Science Abstracts** of particular interest to N.A.A.S. officers are No. 25 on "Antibiotics in Milk" by A. J. Overby (Denmark); No. 26 "The direct influence of climate on milk production" by J. Hancock (New Zealand); No. 28 on "The Lactobacilli: a review of the literature with special reference to taxonomy" by Mary and C. A. E. Briggs (Great Britain); and No. 29 "The importance of pasture plant oestrogens in the reproduction and lactation of grazing animals" by G. S. Pope (Great Britain). Other articles of a more industrious nature have been on the theory of churning, formulae for blending and standardizing milk, the disposal of dairy wastes and dairying developments in New Zealand, Brazil and South Asia. All these review articles are reprinted for the benefit of those who wish to collect them separately from the journal and can be obtained for 1s. 3d. post free.

First published in 1939, *Dairy Science Abstracts* continues to be the leading journal recording in abstract form the publications on dairy science, technology and economics from all over the world. Each month several hundred such abstracts are published together with a review article on some such specialized aspect of dairy science. By a regular perusal of *Dairy Science Abstracts* the advisory officer, dairy manager and many others interested in the production and processing of milk and milk products, are kept informed of what is new in research and development in this and other countries.

Bureau of Pastures and Field Crops

Methods of Surveying and Measuring Vegetation. D. Brown, 1954. 240 pp. quarto, cloth bound; illustrated with half-tones, line drawings and tables; index, glossary, bibliography. 35s. Those interested in grazing land will find, in the first part of this book, a short account of types of grassland found in different parts of the world. For the purpose of this publication, which is the quantitative estimation of vegetation, grazing land is classified according to the growth form and size of the dominant species. On this practical basis, which is in no way an ecological one, five types of grazing land have been distinguished; open grasslands, dense grasslands, open grassland/shrub, dense grassland/shrub, and pure shrub.

Reviews of parts II, III and IV of this book will appear in subsequent issues of this Review.

Copies of all Bureaux publications can be obtained from the Central Sales Branch, Commonwealth Agricultural Bureaux, Farnham House, Farnham Royal, nr. Slough, Bucks.

PROVINCIAL NOTE

THE GOWER PENINSULA

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The Gower peninsula is situated in the westernmost part of Glamorgan, bounded on the south by the Bristol Channel and on the north by the estuary of the River Loughor. It is separated from the Vale of Glamorgan by Swansea Bay and from South Pembrokeshire by Carmarthen Bay. Geographically it may be considered to be a part of the South Wales coastal plain, but it has a character of its own.

Gower is roughly rectangular in shape with an area of 80 square miles and a coastline of 50 miles. On the south coast there are a large number of small bays making this area a favourite holiday resort. A feature peculiar to Gower is the open field system that still survives in the Rhossilli parish.

The highest point in the peninsula (on Cefn Bryn), 600 ft. above sea level, is roughly in the centre and is surrounded by a plateau some 200 ft. high with a steep slope to the sea. The soils and contours are fundamental factors in the types of farming practiced. The soils in the southern side of the peninsula are easier to cultivate than those in the north as they are mainly derived from carboniferous limestone, except for some outcrops of old red sandstone at Rhossilli Down, Llanmadoc Hill and Cefn Bryn. The soil derived from the limestone is light to medium loam but gradually becomes heavier towards the coal measures in the north. The soil in the northernmost part is based on coal measures of the Pennant series and is largely composed of common land and indifferent agricultural land. Some of this land is difficult to work owing to a high water table, although with good farming methods it often gives high yields.

The southern part of Gower enjoys a very mild climate with fairly general absence of frosts and this is obviously a great advantage in the growth of crops. This kindness of climate, coupled with the natural shelter of the hills, allows for a wide range of cropping. It also has the effect of reducing the number of cattle that have to be housed in the winter. The mean January temperature at the south-west point of Gower is 42°F. and it is also the sunniest spot in Glamorgan, enjoying a daily average of $4\frac{1}{2}$ hours sunshine throughout the year. The northern part of the peninsula is bleaker and gets less sunshine. The rainfall also increases from south to north.

The Development of Agriculture in Gower

Agriculture is the main industry in Gower, and a ready market for produce is found in the large industrial area that borders it on the west and north-west. The area of the peninsula is 42,000 acres; 21,000 being crops and grass and 21,000 rough grazing, commons, woods, foreshore and built-up areas. A notable feature of farming in the area has been the development of market gardening. This began over fifty years ago in the Bishopston area owing to its proximity to the available market. With the coming of road traffic, however, market gardening spread further westwards and during the 1920s was developed in the Rhossilli and Llangennith districts. Development in this area had to follow the expansion of road transport for no railways run into the peninsula.

War-time conditions called for the growing of crops for human consumption. In these districts, due to favourable conditions, emphasis was placed on early potatoes. This practice became well established, and Gower has now become recognized as an important area for early potato growing. This development also led to the extension of market gardening, particularly the growing of broccoli and spring cabbage which fit in well with cropping for early potatoes. In the Rhossilli parish the area of glass is greater than in other parts of Gower, although a number of glasshouses are now being built on farms mainly because of their value for early potato chitting.

Formerly the pattern of Gower agriculture was based on stock rearing, beef production and the growing of food for these livestock. Then, as now, the cliff land, marsh saltings and commons were used for stock grazing. Gradually the pattern of farming became wider as various facilities were made available or were improved. Quicker road transport allowed perishable products such as milk to find a quick market and opened up distant markets such as the Midlands for early potatoes. Linked with market gardening there is always a stock venture, normally beef and sheep. But, as water supplies have been made available, dairying has also spread into areas where it was not practised before.

In its widest sense the term " mixed farming " applies to Gower, with its many diverse products and systems which can, however, be classified into two main types :

The production of sheep, beef and store cattle, or milk ;

Market gardening coupled with a livestock enterprise.

The latter type is confined to areas along the south and south-west coastline.

Since more feedingstuffs have become available, livestock enterprises have been intensified, and in particular the production of pigs and table poultry has increased rapidly.

Recent Changes

It is interesting to trace some of the new ventures in Gower since the end of the war.

A co-operative body of farmers was the first in the country to earn a government grant towards the installation of a grass dryer, and this brought in a number of new techniques, including the use of special seed mixtures and the growing of a wider range of crops for drying.

Recently, sugar beet has been introduced into the area and the results to date have been satisfactory, yields on some of the farms being twice the national average. Farms in the Gower area are well mechanized with modern machinery which is continually being supplemented as new machines become available. The region is well served by agricultural contractors operating a variety of specialized equipment. On some farms in the south of Gower a start has been made on flower growing for the local market. This shows signs of developing as it is a means of securing ready cash by intensive cultivation.

Owing to the large area of common land, much interest is taken in commoners' rights. A few years ago the Cefn Bryn Commoners' Committee was resurrected and later the Gower Commoners' Association was formed. All Commoners' Committees in Gower are now members of this Association. Some of these commoners have undertaken improvements to the commons.

It is also worthy of note that the Gower Peninsula, along with adjoining areas, is now an attested area.

Types of Holdings

There are approximately 450 holdings in Gower and these range from small holdings of 2 to $2\frac{1}{2}$ acres up to farms of 400 acres. 40 per cent of the farms are under 25 acres and 83 per cent under 100 acres.

Many of these holdings are family farms employing little or no outside labour. However, some of the larger farms with intensive market gardening enterprises carry a large complement of regular workers and, in addition, take on casual labour at certain periods. This casual labour is usually transported by the farmer from the adjoining urban areas.

The following two farms typify the main systems of farming practised in the peninsula :

Farm A : Dairying and Sheep

Acreage 56

Stock

Dairy Cows	22
Followers	10
Ewes	60
Sows	2

Tillage 24 acres

Crops	(*acres*)
Oats	6
Mixed Corn	10
Mangolds	1
Swedes	1
Kale	3
Potatoes	3

Labour

In addition to the farmer and his wife, one boy is employed, with casual help at certain periods.

All the crops are used for stock feeding with the exception of potatoes. Grass is conserved in the form of hay and silage. The mixed corn grown consists of barley and oats, the barley variety being Hen Gymro and the oat variety being Milford. Early potatoes comprise a third of the potato acreage grown; varieties being Home Guard, Arran Pilot or Craig's Alliance. The maincrop variety is Majestic. Potatoes are sprayed against blight; the earliest spray being applied in early June. Yields of potatoes vary from 4 tons at first lifting of the earlies to 12 tons for the maincrop.

Milk production is about 17,000 gallons per annum. Grassland management is fairly intensive, use being made of electric fencing and of Italian ryegrass undersown in spring corn.

Farm B: Beef, Sheep and Market Gardening

Acreage 130 plus 100 acres common grazings
Tillage 67 acres

Stock		*Crops*	(*acres*)
Beef Cattle	60-80	Oats and Barley ..	20
Cows*	8	Mangolds	4
Ewes	200	Swedes	1
		Sugar Beet	2
**For rearing purposes.*		Potatoes	30
		Cabbage	10

Labour

In addition to the farmer, eight regular men are employed and casual help is engaged during certain periods.

About 30 cattle are sold each year either as forward stores or fat. Calves are purchased and reared on the farm. The sheep flock grazes on the common and also feeds on residues of the market garden and sugar beet crops. About 240 lambs are produced each year.

In addition to the crops listed above, intensive catch cropping is practised, depending on markets; crops, such as beetroots, carrots, savoys and spring cabbages are grown.

Apart from the two main types of farming, slight variations of these are practised on a large number of farms. Farms which carry an acreage of market garden make as much farmyard manure as possible to maintain fertility, and, to supplement this, carry out catch cropping with green manuring crops, such as grasses, legumes or lupins. In addition, substantial quantities of fertilizers are generally used on all crops, including grass, and yields are in the main well above average.

Future Prospects

What are the possibilities of future development? Present trends seem to indicate a further intensification of cropping in the whole of the area. The sheltered position and the proximity to a good market will always favour this. The growing of crops for human consumption and the production of table poultry and flowers are all capable of much further development in an area of this kind. Soil and climate are suitable for intensive cultivation and considerable areas of common land could, if enclosed and cultivated, produce early and heavy crops.

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Appendix

Note : Parts I to V of this Report constitute the Report of Proceedings under the Diseases of Animals Acts.

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